

GLOBAL RESEARCH OUTPUT ON LASER IN MEDICAL

FIELD: A BIBLIOMETRIC STUDY

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ABSTRACT

The research aims to study the growth of research output on the use of Laser in Medical Sciences. The global multidiscipline citation database 'Scopus' was used for this study. A total of 180261 records contributed globally over a period between 1981 to 2015. This study found that a steady growth could be seen on the research output and three fourth of the publications (84.11%) are in English language. Among the 180261 publications, 77.02% of the publications are in journal articles and 28.40% publications are from United States. Among the top 20 countries, India is placed in 15th position with 3034(1.68%) of publications.

KEY WORDS: Bibliometric Study, Growth and Research Output, Laser, Medical Sciences, Scientometric

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INTRODUCTION

Publications are brought to new things or awesome results, new inventions and so on. It means to disclose the unknown things to known things to the research community. In Science and Technology field, it is quite very normal to invent new things or practices and explore to the scientists through publications especially scientific scholarly journals. Scientists and researchers can utilize these results and make to find new things for their new inventions which leads to growth of the domain.

Metrics studies in library and information science such as librametrics, bibliometrics, scientometrics, and informetrics are well known and a number of studies have been carried out in these areas. The metric studies are used to measure scholarly communication; identify research trends and growth of knowledge; identify users of different subjects; estimate comprehensiveness of secondary periodicals; forecast past, present and future publishing trends; adopt an accurate weeding and stacking policy; develop norms and standardization; identify authorship and its trends in documents on various subjects; predict productivity of publishers, individual authors, organizations, country or that of an entire discipline. The recent years have witnessed the application of Scientometric in identifying the growth of literature in a particular domain. Scientometric covers research of all network based communication using informetric or other quantitative measure.

LASER IN MEDICAL SCIENCES

Laser – Light Amplified Stimulated Emission Radiation, unlike a standard light beam, is a source of monochromatic, coherent and unidirectional light. Lasers are installed widespread in everyday life across multiple numerous applications (Ferlay et al., 2010). In the medical field, lasers are diagnostic and therapeutic instrumentsthat offer a whole range of solutions. The laser which enables for greater surgical precision is

lessinvasive and promotes healing time or cure. The energy delivered by laser, whose intensity can be modulated, can cut, destroy or alter the cellular or extracellular structure of biological tissue. In addition, laser applications have the advantage of reducing the risk of infection or promoting healing. Now integrated in surgical procedures, for a better focus and precise cutting, laser surgery is not however without risks for pregnancy or contra-indications for the use of photosensitizing drug.

REVIEW OF LITERATURE

In recent years, scientometric study has been used to analyse the research outcome of a particular domain area either globally or into a particular nation. In the recent past, the study on scientometric, bibliometric and other related areas are increasing which results in bringing out the type of publications and the literature published in the research. The output of the studies helps the researchers to focus on their research with the help of published cited or non-cited publications. The derived statistics that measure the contribution of scientific publications within a given topic could represent the current research trends and also used to identify the focus on new research area. (Garfield, 1970) and helps in mapping of two different knowledge domains (Su HN, 2010). “Mooghali, et al., 2011) gave a complete review of the evolution of the field of scientometrics based on its literature published during 1980 and 2009.” Global trends on the publications on various areas have been studied widely by various authors(Yang, et al., 2013; Elango, Rajendran & Manickraj., 2013). These studies gave a picture on the no. of publications published during a particular period including the no. of publications, authorship pattern, language of publication and so on. Like the global trends, there have been no. of authors attempted on the growth of literature in a particular region in various areas (Karpagam et al., 2011, Keerti and Kumar 2011, Ramesh et al. 2014). Based on the studies, the authors of this paper attempted to study the growth of Indian brain tumor literature compared with the global output.

OBJECTIVES

The objectives of the study are

- To examine the worldwide research output on Laser in Medical Sciences during the period 1981 - 2015.
- To analyse the bibliographic form/document type of the publications on Laser in Medical Sciences.
- To identify the organisations conducting the research on Laser in Medical Sciences
- To identify the top global authors conducting research on Laser in Medical Sciences
- To identify the top source titles those carry the research productions on Laser in Medical Sciences.
- To identify the language where more research outputs are published

HYPOTHESES

The following hypotheses will be formulated for this study based on the objectives.

- There are more literatures published worldwide on Laser in Medical Sciences.
- Growth of literature Laser in Medical Sciences is comparatively higher in developed countries.
- The research productivity Laser in Medical Sciences is dominated by English language.
- Journals are major source of publications on Laser in Medical Sciences.

- There exists no steady growth in research output Laser in Medical Sciences research.

SEARCH TERM

Your Query: ((TITLE-ABS-KEY(laser) AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL) AND PUBYEAR > 1980 AND PUBYEAR < 2016))

ANALYSIS

The global research output on Laser in Medical Sciences has been analysed using various scientometric / bibliometric tools such as Rate of Growth (RoG), Relative Growth Rate (RGR) and Doubling Time (Dt) apart from the percentage and cumulative percentage. The literature on Laser in Medical Sciences covered in SCOPUS bibliographic database has been considered for the purpose of quantitative analysis. The data retrieved on laser in medical sciences were for the period 1981 to 2015 and a total of 180261 records were found.

Quantum of Literature on Laser in Medical Sciences

The year wise distribution of literature on Laser in Medical Sciences with its total publications (TP), percentage, cumulative, cumulative percentage and RoG were calculated and the same is shown in Table 1 and Figure 1 and 2.

Table 1: Year Wise Contribution

S. No.	Year	Papers	%	CUM	CUM %	RoG
1	1981	877	0.49	877	0.49	1.00
2	1982	968	0.54	1845	1.03	2.10
3	1983	1217	0.68	3062	1.70	1.66
4	1984	1647	0.91	4709	2.62	1.54
5	1985	1857	1.03	6566	3.65	1.39
6	1986	1829	1.01	8395	4.66	1.28
7	1987	2061	1.14	10456	5.80	1.25
8	1988	2305	1.28	12761	7.08	1.22
9	1989	2744	1.52	15505	8.60	1.22
10	1990	3150	1.75	18655	10.35	1.20
11	1991	3053	1.69	21708	12.05	1.16
12	1992	3314	1.84	25022	13.88	1.15
13	1993	3472	1.93	28494	15.81	1.14
14	1994	3568	1.98	32062	17.79	1.13
15	1995	3794	2.10	35856	19.89	1.12
16	1996	4667	2.59	40523	22.48	1.13
17	1997	4651	2.58	45174	25.06	1.11
18	1998	4377	2.43	49551	27.49	1.10
19	1999	4346	2.41	53897	29.90	1.09
20	2000	4807	2.67	58704	32.57	1.09
21	2001	4932	2.74	63636	35.31	1.08
22	2002	5003	2.78	68639	38.08	1.08
23	2003	5581	3.10	74220	41.18	1.08
24	2004	5791	3.21	80011	44.39	1.08
25	2005	6161	3.42	86172	47.81	1.08
26	2006	6815	3.78	92987	51.59	1.08
27	2007	6922	3.84	99909	55.43	1.07
28	2008	7701	4.27	107610	59.70	1.08
29	2009	8488	4.71	116098	64.41	1.08
30	2010	9202	5.10	125300	69.51	1.08
31	2011	9235	5.12	134535	74.64	1.07

Table 1: Contd.,						
32	2012	9532	5.29	144067	79.92	1.07
33	2013	10779	5.98	154846	85.90	1.07
34	2014	13032	7.23	167878	93.13	1.08
35	2015	12383	6.87	180261	100.00	1.07
Total		180261	100.00			

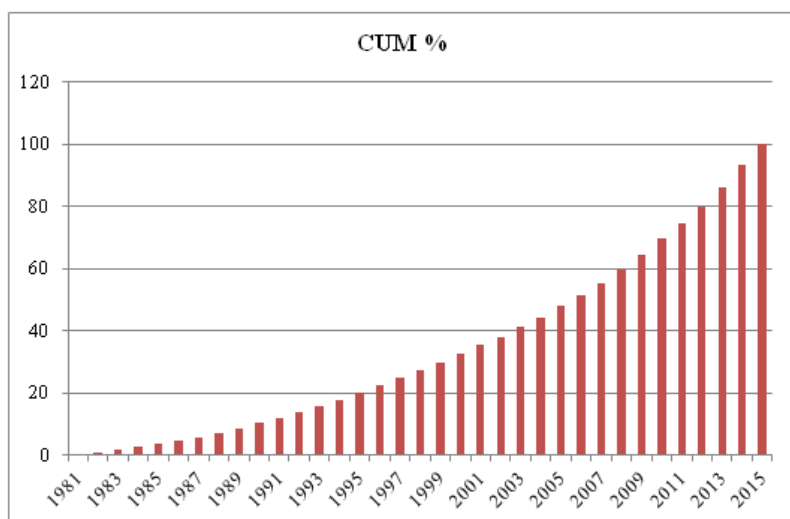


Figure 1: Year Wise Cumulative Research Productivity

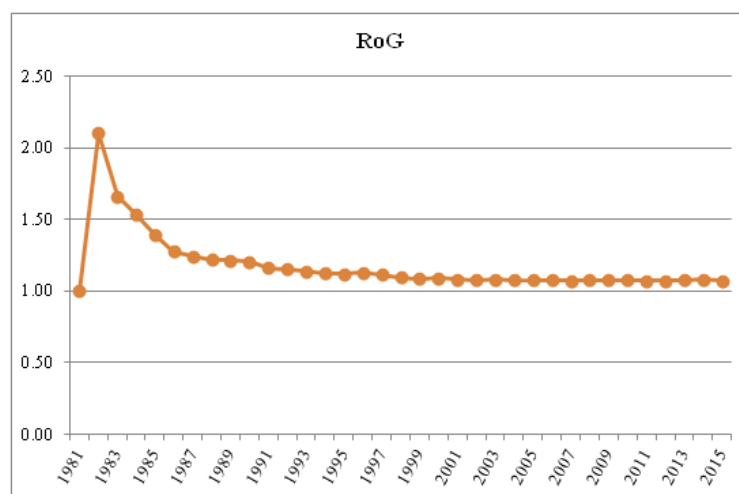


Figure 2: Laser on Medical Sciences Research Vs Year & RoG

It is seen from the Table 1 and Figures 1 and 2 and 4.3 that the total number of publications is less than 1000 in first two years (1981 and 1982) of the study 1981 to 2015. From the year 1983, the research output on laser in medical sciences could be seen in upward direction and the data reveals that a periodical growth could be seen till the year 2015 i.e end of the study period. It is also interesting to note that from the year 2010 onwards, the total publication in each year reaches above 9000 and in the year 2014 it is 7.23% (13032) and a slight decrease in the publication can be seen in the year 2015 (6.87%, 12383). The cumulative total of the publication is 180261.

The Ratio of Growth (RoG) varies from 1.00 to 2.10 between the study period from 1981 to 2015. The RoG shows the steady growth on the research output on laser in medical sciences. Also the RoG is between 1.07 and 1.10 for the years

1998 – 2015, 1.11 to 1.20 for the years 1990 to 1997 and 1.22 to 2.10 for the years 1982 to 1996 except 1.00 for the year 1981. This confirms that researchers are interested to publish papers on laser in medical sciences.

Relative Growth Rate (RGR) and Doubling Time (DT) of Research Productivity on Laser in Medical Sciences

The research productivity on Laser in Medical Sciences have been calculated based on RGR and the Dt () which is shown in table 2 and figure 3. The Relative Growth Rate (RGR) is the increase in number of articles/pages per unit of time. This definition is derived from the definition of relative growth rates in the study of growth analysis of individual plants and effectively applied in the field of botany (Hunt, R 1978), which in turn, had its origin from the study of the rate of interest in the financial investment (Blackman, V.H. 1919). The mean Relative Growth Rate (RGR) over the specific period of interval can be calculated from the following equation:

$$\text{RGR } 1-2 \bar{R} = \frac{\log_e {}_2W - \log_e {}_1W}{{}_2T - {}_1T}$$

where as

$1-2 \bar{R}$ =mean relative growth rate over the specific period of interval

$\log_e {}_1W$ =log of initial number of articles/pages

$\log_e {}_2W$ =log of final number of articles/pages after a specific period of interval

${}_2T - {}_1T$ =the unit difference between the initial time and the final time

The year can be taken here as the unit of time. The RGR for both articles and pages can be calculated separately. Therefore

- $1-2 \bar{R}_{(aa-1 \text{ year } -1)}$: Can represent the mean relative growth rate per unit of articles per unit of year over a specific period of interval and
- $1-2 \bar{R}_{(pp-1 \text{ year } -1)}$: Can represent the mean relative growth rate per unit of pages per unit of year over a specific period of interval.

DOUBLING TIME (Dt (P))

There exists a direct equivalence between the relative growth rate and the doubling time. If the number of articles/pages of a subject doubles during a given period then the difference between the logarithms of numbers at the beginning and end of this period must be the logarithms of number 2. If natural logarithm is used this difference has a value of 0.693. Thus the corresponding doubling time for each specific period of interval and for both articles and pages can be calculated by the following formula:

$$\text{Doubling time (Dt)} = \log_e 2 / \bar{R}$$

Therefore

$$\text{Log}_e 2$$

Doubling time for articles Dt (a) = _____

$$1 - 2 \bar{R} \text{ (aa-1 year-1)}$$

$$\text{Log}_e 2 = 0.693$$

Table 2: Research Productivity on Laser in Medical Sciences Vs RGR and Dt ()

S. No.	Year	Papers	%	CUM	CUM %	w1	w2	RGR	Dt
1	1981	877	0.49	877	0.49		6.776507	6.78	0.10
2	1982	968	0.54	1845	1.03	6.776507	7.520235	0.74	0.93
3	1983	1217	0.68	3062	1.70	7.520235	8.026824	0.51	1.37
4	1984	1647	0.91	4709	2.62	8.026824	8.457231	0.43	1.61
5	1985	1857	1.03	6566	3.65	8.457231	8.78966	0.33	2.08
6	1986	1829	1.01	8395	4.66	8.78966	9.035392	0.25	2.82
7	1987	2061	1.14	10456	5.80	9.035392	9.254931	0.22	3.16
8	1988	2305	1.28	12761	7.08	9.254931	9.454149	0.20	3.48
9	1989	2744	1.52	15505	8.60	9.454149	9.648918	0.19	3.56
10	1990	3150	1.75	18655	10.35	9.648918	9.833869	0.18	3.75
11	1991	3053	1.69	21708	12.05	9.833869	9.985436	0.15	4.57
12	1992	3314	1.84	25022	13.88	9.985436	10.12751	0.14	4.88
13	1993	3472	1.93	28494	15.81	10.12751	10.25745	0.13	5.33
14	1994	3568	1.98	32062	17.79	10.25745	10.37543	0.12	5.87
15	1995	3794	2.10	35856	19.89	10.37543	10.48727	0.11	6.20
16	1996	4667	2.59	40523	22.48	10.48727	10.60962	0.12	5.66
17	1997	4651	2.58	45174	25.06	10.60962	10.71828	0.11	6.38
18	1998	4377	2.43	49551	27.49	10.71828	10.81076	0.09	7.49
19	1999	4346	2.41	53897	29.90	10.81076	10.89483	0.08	8.24
20	2000	4807	2.67	58704	32.57	10.89483	10.98026	0.09	8.11
21	2001	4932	2.74	63636	35.31	10.98026	11.06093	0.08	8.59
22	2002	5003	2.78	68639	38.08	11.06093	11.13662	0.08	9.16
23	2003	5581	3.10	74220	41.18	11.13662	11.21479	0.08	8.86
24	2004	5791	3.21	80011	44.39	11.21479	11.28992	0.08	9.22
25	2005	6161	3.42	86172	47.81	11.28992	11.3641	0.07	9.34
26	2006	6815	3.78	92987	51.59	11.3641	11.44021	0.08	9.10
27	2007	6922	3.84	99909	55.43	11.44021	11.51202	0.07	9.65
28	2008	7701	4.27	107610	59.70	11.51202	11.58627	0.07	9.33
29	2009	8488	4.71	116098	64.41	11.58627	11.66219	0.08	9.13
30	2010	9202	5.10	125300	69.51	11.66219	11.73847	0.08	9.09
31	2011	9235	5.12	134535	74.64	11.73847	11.80958	0.07	9.74
32	2012	9532	5.29	144067	79.92	11.80958	11.87803	0.07	10.12
33	2013	10779	5.98	154846	85.90	11.87803	11.95019	0.07	9.60
34	2014	13032	7.23	167878	93.13	11.95019	12.03099	0.08	8.58
35	2015	12383	6.87	180261	100.00	12.03099	12.10216	0.07	9.74
Total		180261	100.00						

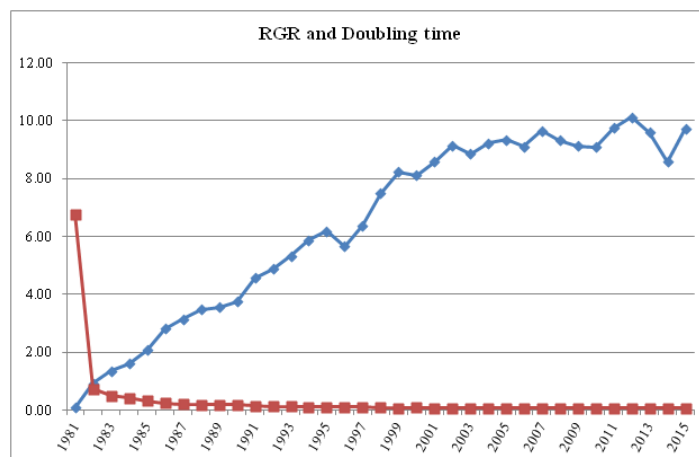


Figure 3: Research Productivity on Laser in Medical Sciences Research Vs RGR & Dt ()

It is observed from the table 2 and figure 3 that the relative growth rate (RGR) lies between 0.07 and 6.78. It is also to note that some of the RGR values are same in few years of the study period. The doubling time ranges between 0.93 and 10.12 for the study period 1981 to 2015. This shows that the publications on laser on medical sciences is increasing and the range of publications are on many folds.

Bibliographic Form

The bibliographic form of publications in respect of the research productivity on Laser in Medical Sciences were analysed and the same is presented in table 3.

Table 3: Research Productivity on Laser in Medical Sciences Vs Bibliographic Form

S. No	Document Type	Publications	Percentage
1	Article	138836	77.02
2	Review	17212	9.55
3	Conference Paper	8730	4.84
4	Letter	5970	3.31
5	Note	2845	1.58
6	Editorial	2404	1.33
7	Short Survey	1819	1.01
8	Book Chapter	1410	0.78
9	Article in Press	437	0.24
10	Erratum	331	0.18
11	Conference Review	162	0.09
12	Book	105	0.06
Total		180261	100.00

It is observed from the table 3 that the research output largely published in subject periodicals and sometimes as reviews. Of course, some of those papers presented in conferences were further updated and published in journals of the respective branch of knowledge. In this study, it is observed that more than three fourth of the contributions (77.02%) were journal articles and 9.55% were review papers and 4.84% were conference papers. By and large it is found that the scholarly communication of laser in medical sciences research output is mostly through journals and reviews.

Language Wise Distributions of Publications

The scholarly communication is effective through English language in almost all the countries irrespective of the

native language of the countries and this phenomenon is not an exception on the research output on laser in medical sciences. The language-wise distribution of the research output is shown in table 4.

Table 4: Research Productivity on Laser in Medical Sciences Vs Language Wise Distribution

S. No	Language	Publications	Percentage
1	English	151616	84.11
2	German	6155	3.41
3	Chinese	5905	3.28
4	Russian	3758	2.08
5	French	3702	2.05
6	Japanese	3526	1.96
7	Spanish	1416	0.79
8	Italian	1171	0.65
9	Polish	804	0.45
10	Portuguese	553	0.31
11	Czech	415	0.23
12	Turkish	333	0.18
13	Dutch	253	0.14
14	Korean	228	0.13
15	Hungarian	176	0.10
16	Danish	134	0.07
17	Romanian	116	0.06
Total		180261	100.00

The maximum of 84.11% of the total research output were only in English. This is followed by German (3.41%) and Chinese (3.28 %) language. It is significant to note that some contributions are published in more than one language simultaneously. In other words the publications were in Russian, French, Japanese, Spanish, German etc.

Country Wise Publications

The growth of literature of any research globally is gauged through the region or the country where more no of publications are published. The researcher also studied the country wise publication on laser in medical sciences for the period 1981 to 2015 which helps to find out the total no. of publications published in the subject. The top 20 country publications were shown in table 5. The details of total no. of publications along with the percentage of contribution globally is shown in table 5.

Table 5: Country Wise Research Publications

S. No	Country	Publications	Percentage
1	United States	51196	28.40
2	Germany	17562	9.74
3	Japan	13592	7.54
4	United Kingdom	12378	6.87
5	China	12146	6.74
6	France	7159	3.97
7	Italy	7031	3.90
8	Canada	4581	2.54
9	Spain	3840	2.13
10	Brazil	3793	2.10
11	Netherlands	3712	2.06
12	Australia	3500	1.94
13	Switzerland	3313	1.84
14	South Korea	3160	1.75
15	India	3034	1.68

Table 5: Contd.,			
16	Sweden	2631	1.46
17	Turkey	2464	1.37
18	Austria	2362	1.31
19	Taiwan	1996	1.11
20	Belgium	1840	1.02
21	Other	18971	10.52
Total		180261	100.00

Table 5 reveals that maximum of publications i.e 28.40% were from the United States followed by Germany (9.47%) and Japan (7.54%). It is also to note than India occupies 15th position with total production of 1.68%. 89.48% of the research publications are from the top 20 countries.

Highly Published Institutions

The publications on laser in medical sciences published by the authors with from various institutes around the globe and the authors affiliation with the institutes are taken for the study. Table 6 enumerates the affiliation of the authors or the institutes which have more than 500 publications.

Table 6: Research Productivity Vs Affiliation

S. No	Affiliation	Papers	Percentage N=180261
1	Universidade de Sao Paulo - USP	1431	0.79
2	Massachusetts General Hospital	1235	0.69
3	Harvard Medical School	1215	0.67
4	VA Medical Center	1081	0.60
5	Ludwig-Maximilians-Universitat Munchen	1038	0.58
6	University of California, San Francisco	859	0.48
7	University of California, San Diego	838	0.46
8	Charite - Universitatsmedizin Berlin	817	0.45
9	Mayo Clinic	770	0.43
10	UCL	770	0.43
11	Cleveland Clinic Foundation	757	0.42
12	UC Irvine	678	0.38
13	Universitat Heidelberg	658	0.37
14	University of Toronto	647	0.36
15	Medizinische Universitat Wien	635	0.35
16	David Geffen School of Medicine at UCLA	634	0.35
17	University of Miami Leonard M. Miller School of Medicine	629	0.35
18	Friedrich-Alexander-Universität Erlangen-Nürnberg	622	0.35
19	Shanghai Jiaotong University	609	0.34
20	Academic Medical Centre, University of Amsterdam	585	0.32
21	Universita degli Studi di Roma La Sapienza	566	0.31
22	Moorfields Eye Hospital NHS Foundation Trust	564	0.31
23	University of Washington, Seattle	530	0.29
24	University of Texas M. D. Anderson Cancer Center	518	0.29
25	Inserm	517	0.29
26	Peking University	512	0.28
27	University of California, Los Angeles	511	0.28
28	The Johns Hopkins School of Medicine	503	0.28
29	Universita degli Studi di Milano	502	0.28
30	Fudan University	500	0.28
Total		21731	12.06

The institutes which have more than 500 publications are shown in table 6. Among the 30 institutes Universidade de Sao Paulo – USP which has 1431 (0.79%) publications followed by Massachusetts General Hospital, 1235 (0.69%) and Harvard Medical School, 1215 (0.67). Fudan University has the least i.e 500 (0.28%) publications among the top 30 institutes.

Source Titles on Laser in Medical Sciences

The core journals which publishes more than 500 research work on laser in medical sciences has been presented in table 7.

Table 7: Research Productivity Vs Source Title

S. No	Source Title	Papers	Percentage
1	Journal Of Cataract And Refractive Surgery	3053	1.69
2	Progress In Biomedical Optics And Imaging Proceedings Of SPIE	2956	1.64
3	Lasers In Surgery And Medicine	2884	1.60
4	Investigative Ophthalmology And Visual Science	2717	1.51
5	Lasers In Medical Science	2148	1.19
6	Ophthalmology	2043	1.13
7	Plos One	1845	1.02
8	Journal Of Refractive Surgery	1764	0.98
9	American Journal Of Ophthalmology	1694	0.94
10	Dermatologic Surgery	1469	0.81
11	Archives Of Ophthalmology	1321	0.73
12	British Journal Of Ophthalmology	1211	0.67
13	Proceedings Of The National Academy Of Sciences Of The United States Of America	1128	0.63
14	Photomedicine And Laser Surgery	1121	0.62
15	Science	1102	0.61
16	Retina	1086	0.60
17	Nature	996	0.55
18	Graefe S Archive For Clinical And Experimental Ophthalmology	836	0.46
19	Klinische Monatsblätter Fur Augenheilkunde	811	0.45
20	Japanese Journal Of Clinical Ophthalmology	798	0.44
21	Journal Of Clinical Laser Medicine And Surgery	759	0.42
22	International Journal Of Ophthalmology	713	0.40
23	Journal Of Urology	709	0.39
24	Cornea	672	0.37
25	Scientific Reports	644	0.36
26	Laryngoscope	638	0.35
27	Journal Of Endourology	629	0.35
28	Eye	623	0.35
29	Folia Ophthalmologica Japonica	615	0.34
30	Photochemistry And Photobiology	596	0.33
31	Ophthalmologie	578	0.32
32	Journal Of Biomedical Optics	570	0.32
33	Journal Francais D Ophthalmologie	557	0.31
34	Journal Of Cosmetic And Laser Therapy	553	0.31
35	Gastrointestinal Endoscopy	534	0.30
36	Urology	528	0.29
37	Journal Of The American Academy Of Dermatology	512	0.28
38	Journal Of Glaucoma	508	0.28
Total		43921	24.37

A total 180261 contribution on laser in medical sciences literature were published in various bibliographic forms out of which 77.02% were published in the form of journal articles. The highly productive articles in journals are ranked and the first five ranked journals are:

- Journal of Cataract and Refractive Surgery with 3053 (1.69%) publications
- Progress in Biomedical Optics and Imaging Proceedings of SPIE amounting to 2956 (1.64%)
- Lasers in Surgery and Medicine with 2884 (1.60%) publications
- Investigative Ophthalmology and Visual Science has 2717 (1.51%) publications
- Lasers in Medical Science with 2148 (1.19%) publications.

Highly Published Authors

Among the 180261 publications, table 8 shows the authors with more than 100 publications. 53 authors have more than 100 publications with a total output of 6821 (3.78%).

Table 8: Highly Published Authors

S. No.	Name of the Author	No. of Publications	Percentage
1	Weinreb, R.N.	201	0.11
2	Landthaler, M.	197	0.11
3	Goldberg, D.J.	196	0.11
4	Mordon, S.	188	0.10
5	Berns, M.W.	174	0.10
6	Nelson, J.S.	172	0.10
7	Alió, J.L.	163	0.09
8	Birngruber, R.	158	0.09
9	Seiler, T.	156	0.09
10	Schmetterer, L.	154	0.09
11	Lam, D.S.C.	151	0.08
12	Marshall, J.	151	0.08
13	Alster, T.S.	148	0.08
14	Peyman, G.A.	146	0.08
15	Geronomus, R.G.	142	0.08
16	Kohnen, T.	141	0.08
17	Seitz, B.	141	0.08
18	Coscas, G.	135	0.07
19	Brancato, R.	131	0.07
20	Raulin, C.	128	0.07
21	Araie, M.	125	0.07
22	Krueger, R.R.	125	0.07
23	Ritch, R.	125	0.07
24	Langenbucher, A.	120	0.07
25	Sroka, R.	119	0.07
26	Matsumoto, K.	118	0.07
27	Pinheiro, A.L.B.	118	0.07
28	Soubrane, G.	115	0.06
29	Van Gemert, M.J.C.	115	0.06
30	Tsubota, K.	114	0.06
31	Shields, J.A.	112	0.06
32	Dover, J.S.	111	0.06
33	Puliafito, C.A.	111	0.06
34	Shapshay, S.M.	111	0.06

Table 8: Contd.,			
35	Vogl, T.J.	111	0.06
36	Azar, D.T.	110	0.06
37	Goldman, M.P.	110	0.06
38	Naumann, G.O.H.	110	0.06
39	Welch, A.J.	110	0.06
40	Shields, C.L.	109	0.06
41	Holz, F.G.	108	0.06
42	Yoshida, A.	108	0.06
43	Anderson, R.R.	106	0.06
44	Fankhauser, F.	106	0.06
45	Belcaro, G.	105	0.06
46	Bressler, N.M.	104	0.06
47	Wilson, S.E.	103	0.06
48	Bandello, F.	102	0.06
49	Pallikaris, I.G.	102	0.06
50	Yoshimura, N.	102	0.06
51	Bjerring, P.	101	0.06
52	Brinkmann, R.	101	0.06
53	Tano, Y.	101	0.06
Total		6821	3.78

It is seen from table 8 that Weinreb, R.N. with 201 (0.11%) has the maximum no. of publications followed by Landthaler, M. with 197 and Goldberg, D.J. 196 publications. Mr.Tano, Y has the least publications (101 (0.06%) among the authors who have more than 100 publications.

FINDINGS

The major findings with reference to the analysis are presented below:

- A total of 180261 publications were published between the period 1981 to 2015 on use of laser in medical sciences.
- The total number of publications is less than 1000 in first two years (1981 and 1982) of the study 1981 to 2015. From the year 1983, the research output on laser in medical sciences could be seen in upward direction.
- From the year 2010 onwards, the total publication in each year reaches above 9000 and in the year 2014 it is 7.23% (13032) and a slight decrease in the publication can be seen in the year 2015 (6.87%, 12383).
- The Ratio of Growth (RoG) varies from 1.00 to 2.10 between the study period from 1981 to 2015.
- The RoG shows the steady growth on the research output on laser in medical sciences as the RoG is between 1.07 and 1.10 for the years 1998 – 2015, 1.11 to 1.20 for the years 1990 to 1997 and 1.22 to 2.10 for the years 1982 to 1996 except 1.00 for the year 1981.
- The relative growth rate (RGR) lies between 0.07 and 6.78. It is also to note that some of the RGR values are same in few years of the study period.
- The doubling time ranges between 0.93 and 10.12 for the study period 1981 to 2015. This shows that the publications on laser on medical sciences is increasing and the range of publications are on many folds.

- More than three fourth of the contributions (77.02%) were journal articles and 9.55% were review papers and 4.84% were conference papers.
- The maximum of 84.11% of the total research output were only in English. This is followed by German (3.41%) and Chinese (3.28 %) language.
- The maximum of publications i.e 28.40% were from the United States followed by Germany (9.47%) and Japan (7.54%). It is also to note than India occupies 15th position with total production of 1.68%.
- 89.48% of the research publications are from the top 20 countries.
- Universidade de Sao Paulo – USP which has 1431 (0.79%) publications followed by Massachusetts General Hospital, 1235 (0.69%) and Harvard Medical School, 1215 (0.67). Fudan University has the least i.e 500 (0.28%) publications among the top 30 institutes.
- Journal of Cataract and Refractive Surgery with 3053 (1.69%) publications, Progress in Biomedical Optics and Imaging Proceedings of SPIE amounting to 2956 (1.64%), Lasers in Surgery and Medicine with 2884 (1.60%) publications, Investigative Ophthalmology and Visual Science has 2717 (1.51%) publications and Lasers in Medical Science with 2148 (1.19%) publications.
- Weinreb, R.N. with 201 (0.11%) has the maximum no. of publications followed by Landthaler, M. with 197 and Goldberg, D.J. 196 publications. Mr.Tano, Y has the least publications (101 (0.06%) among the authors who have more than 100 publications.

CONCLUSIONS

The research output on the use of laser in medical has been studied in the light of the global research has been taken for the study with the use of global database SCOPUS. The data which were analysed is for the period 1981 to 2015. A total of 180261 records were retrieved in the database for analysis purpose. This study reported the findings to determine the publication trend with respect to growth of literature on year wise, language wise and country wise with the bibliographic form where the publications are published. This study also enumerated the affiliation of the authors, source titles and the top global authors. The objectives and the hypotheses set for this study were thoroughly investigated. The results computed were quite encouraging particularly on the use of laser in medical sciences. This study also found that there is a steady growth on the research publications on laser in medical sciences and almost all the developed and developing countries contributed to the research on the use of laser in medical sciences. It is also to note that Indian contribution is also remarkable in this research.

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